

Al
Conell
closely adjacent said obstruction on said other side and said data is stored on said other side for subsequent retrieval.

Amend Claim 6 as follows

AS
6. Apparatus for transmitting data in a borehole, the apparatus comprising a transmitter and a receiver; the transmitter including means for converting data parameters into an electric signal and first transducer means responsive to said electric signal to generate an acoustic signal, the first transducer means being adapted for physical coupling to an elongate tubular member having an internal bore extending along the borehole whereby the acoustic signal is propagated in said elongate tubular member; the receiver comprising second transducer means adapted for physical coupling to said elongate tubular member to produce an electrical output corresponding to said acoustic signal, and signal processing means connected to receive said output and operative to process the data into a condition for onward transmission; characterised in that said signal processing means includes memory means for storing received data, and means for transferring data from the memory means to a pick-up tool lowered to an adjacent location in the borehole; and in that the apparatus is adapted for use in transmitting data from one side to the other of an obstruction blocking said internal bore of said elongate tubular member, the first transducer means being coupled, in use, to said tubular member at a first location closely adjacent said obstruction on said one side and the second transducer means being coupled, in use, to the elongate tubular member at a second location closely adjacent said obstruction on said other side.

Delete Claim 7, without prejudice.

IN THE DRAWINGS

Amend Figs. 2, 3 and 4 as shown in the attached copies.

COMMENTS

Claims 1-13 stand rejected as being obvious in the light of Montgomery or Bockhorst when taken in combination with Grossman and Close et al or Arriens.

As has been correctly noted by the Examiner, Montgomery and Bockhurst show the use of acoustic signal transmission in a drill string, in which an electrical data signal is converted to an acoustic signal which is transmitted along the length of the drill string. It has been shown by the International Search Report that there have been numerous proposals of this sort for the use of acoustic signals to transmit data along drill strings.

It is significant that all of these proposals have related to systems in which the data is acoustically transmitted from a downhole location to the surface; ie they have all sought to use acoustic transmission in the drill string as a substitute for electrical transmission using cables or the like or hydraulic transmission through the drilling fluid. These proposals date back as early as 1971, and it is clear from the various cited references that significant difficulties are encountered in successfully transmitting acoustic signals over the substantial distances involved between the downhole location where the data is obtained and the surface. These references put forward conflicting ideas regarding the manner in which these difficulties might be overcome, as regards preferred carrier frequencies for example. To the knowledge and belief of the Applicant, the idea of using acoustic data transmission between a downhole location and the surface has never been successfully implemented in practice,

despite continuous investigation of the idea over an extended period (as evidenced by the patent literature).

The present invention exploits the idea of acoustic data transmission by using it for data transmission over a relatively short path length, in circumstances where the conventional data transmission path (eg electrical or hydraulic) is blocked by an obstruction such as a shut-in valve. This allows acoustic data transmission to be applied in a situation where it can be reliably employed, in view of the short path length, to provide a bridge past an obstruction which would block a conventional (electrical or hydraulic) data transmission system. Such obstructions would otherwise require complex mechanical arrangements in order to be by-passed by electrical or hydraulic systems, as discussed in the introductory part of the present Application.

It is believed that the invention as defined in the Claims is clearly novel in this regard, and that it overcomes a significant technical problem by utilising a means of data transmission (acoustic transmission) which has been proposed in the past but which has not hitherto been applied in a practical and useful way. On this basis it is submitted that the invention ought to be patentable.

It is accepted that downhole data logging and storage is known, as such, as exemplified by Close et al. However, data stored downhole is subject to the same problems as regards transmission to the surface by conventional means which are addressed by the present invention. With regard to Arriens et al, uphole data storage first requires transmission of the data to the uphole location, which would again be subject to the problems addressed by the present invention (Arriens describes an acoustic transmission system in relation to a steel component; as

noted above, acoustic transmission along the full length of a drill string has not been practical, to date).

It is further accepted that Grossman discloses apparatus in which data logged downhole is transferred by inductive coupling to a retrieval tool, in a manner which is similar to the retrieval of the data from the data storage means located above the obstruction in the preferred embodiment of the present invention. Where the data to be retrieved originates below an obstruction, the data retrieval apparatus of Grossman would be prevented from reaching the relevant location to retrieve the data. That is, the Grossman apparatus, as disclosed, would be subject to the same problems as conventional hydraulic or electrical data transmission systems.

The Examiner's rejection of the Claims is based on the premise that it would be obvious to combine the "conventional" steps of data storage and acoustic transmission and so arrive at the present invention. It is respectfully submitted that the combination of features defined in the Claims is not obvious in the light of the prior art of record.

Firstly, it is conceded that data storage and retrieval, as such, are entirely conventional and well known. The present invention addresses the particular problem of retrieving data from a location positioned below a physical obstruction in a drill string.

Secondly, for the reasons discussed above, the acoustic transmission of data through drill strings cannot be said to be "conventional". The prior art shows that there is substantial interest in the use of acoustic transmission for transmitting downhole data to the surface. This has not proved to be practical and has not yet provided an alternative to the genuinely "conventional" techniques

using electrical or hydraulic signals. If acoustic transmission of the type proposed in the prior art were capable of being used in practice, then this in itself would provide a complete solution to the problem addressed by the present invention. However, this is not the case.

Whilst the various features recited in Claims 1 and 6 can be shown to be known, individually, from various prior art references, there is nothing in those references, when taken alone or in combination, to suggest the combination of those features in the manner defined in the Claims so as to provide a solution to the particular problem with which the invention is concerned.

The invention uses the technique of acoustic transmission, which has long been the subject of interest in the field of borehole data transmission but which has not previously been of practical use, to provide a workable solution to a significant technical problem, by restricting the acoustic transmission to a minimum path length so as to by-pass an obstruction, with the data logging, storage and retrieval on either side of the obstruction being relatively conventional.

It is submitted that the "hybrid" system provided by the invention is neither disclosed nor suggested by the prior art of record and provides clear technical advantages over previous methods for by-passing obstructions. For these reasons it is submitted that the invention as defined in the Claims cannot properly be said to be obvious.

Claims 1 and 6 have been amended to clarify the subject matter of the invention and the distinctions between it and the prior art. In particular, the Claims now refer to "an elongate tubular member having an internal bore" and to an "obstruction blocking said internal bore", and to the conversion of the electrical signal to an acoustic

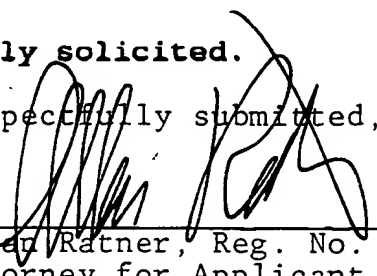
signal and back to an electrical signal taking place at first and second locations "closely adjacent said obstruction" on either side thereof. It is believed that the Claims now define the invention in terms of a combination of features which would not arise directly as a result of the Examiner's notional combination of features from the prior art references, and which more clearly define the subject matter of the invention as regards the solution provided thereby to the problem as discussed above.

In summary, it is submitted that the prior art of record neither discloses or suggests a "hybrid" data transmission system in which an electrical signal is converted to an acoustic signal for transmission over a minimal path length so as to by-pass an obstruction, the acoustic signal subsequently being converted back to an electrical signal for storage prior to retrieval; that such a system provides clear technical advantages over prior art systems for by-passing such obstructions; and that, accordingly, the invention is clearly novel and non-obvious.

Proposed amendments to Figs. 2, 3 and 4 of the drawings are submitted herewith, including verbal labelling as requested by the Examiner. If the Examiner believes that amendment of Fig. 1 is required also, he is requested to specify the relevant changes.

A favourable action is earnestly solicited.

Respectfully submitted,


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Encs - Red-lined Drawings
(2 sheets)
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